

ORIGINAL ARTICLE

The Effects of Relaxation Exercises and Park Walks During Workplace Lunch Breaks on Physiological Recovery

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Considering the increasing demands of various occupational interventions, this study aimed at examining the impact of relaxation exercises and park walks during lunch breaks on physiological recovery (i.e., on changes in cortisol excretion and blood pressure). In a four-week randomized controlled trial, 153 knowledge workers in seven companies were allocated to one of three groups: relaxation, park walk, or control. Both intervention groups were required to undertake either a lunchtime relaxation exercise or a park walk on each working day for two consecutive weeks. Data were collected at baseline, during the two-week intervention period, and in the week after the intervention. Mixed-design analyses of variance (ANOVA) were conducted. No beneficial intervention effects were observed in cortisol awakening response (CARi) or cortisol decline during the day (CDD). Blood pressure decreased significantly in the afternoon at work in each group. This decrease was more pronounced in the park walk group ($d = .51-.58$) than in the relaxation ($d = .18-.28$) and control ($d = .31-.41$) groups. Our study showed that changing knowledge workers' lunch routines for a short period of time does not affect cortisol excretion, but may lower blood pressure at the end of the working day. This lowered blood pressure also seemed to occur among the controls, suggesting that measuring and keeping track of blood pressure may serve as an intervention. However, longer interventions are needed to achieve stronger and long lasting physiological recovery effects.

Keywords: blood pressure; cortisol; lunch break; park walk; recovery; relaxation exercise

Job stress is linked to a wide range of negative health outcomes and impaired well-being (e.g., Chandola, Brunner & Marmot 2006; Ganster & Rosen 2013; Kivimäki et al. 2012). Consequently workplace interventions counteracting stress are crucial to maintaining occupational health. In the present study we focused on lunch breaks as an intervention setting. Lunch breaks typically represent the longest within-workday breaks and are thus likely play an important role in daily job stress recovery (Fritz et al. 2013; Trougakos et al. 2014). By engaging employees in specific recovery activities – either a relaxation exercise or a park walk – during lunchtime, we aimed to decrease their stress levels and restore their energy.

Although the workplace is not the most obvious recovery setting, within-workday recovery is important to maintain high levels of energy and engagement throughout the working day and to prevent accumulation of job stress (Geurts, Beckers & Tucker 2014). Recovery has been identified as an important mechanism to explain how employees

can stay energetic, engaged, and healthy, even when facing high demands and stress at work (Sonnentag & Fritz 2015). Incomplete recovery from job stress may initiate a process, which eventually culminates in chronic health problems, such as prolonged fatigue, sleep disorders, and cardiovascular diseases (Geurts & Sonnentag 2006; Sluiter et al. 2001; Ursin 2000). In the recovery process, physiological factors play a significant role (McEwen & Seeman 1999). From a physiological viewpoint, recovery can be defined in terms of decreasing levels of physiological stress markers. In the present study we evaluate whether a two-week lunchtime intervention affected the physiological stress markers cortisol and blood pressure.

Cortisol and blood pressure as physiological markers of job stress

The hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic-adrenal-medullary (SAM) system are key physiological systems involved in stress-related activation but also in recovering from stress. Cortisol is one of the end products of the HPA-axis and considered a key factor linking the experience of stress to adverse health effects (Chrousos 2009). Blood pressure relates to the SAM system, and high blood pressure is associated with higher

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cardiovascular morbidity and mortality (see Lewington et al. 2002, for a review). Evidence also underscores the importance of psychosocial factors at work in the etiology of cardiovascular diseases (see Backe et al. 2012; Kivimäki et al. 2012, for reviews). According to the allostatic load model (McEwen 1998), stress hormones (i.e., cortisol) are primary mediators, while the cardiovascular system (i.e., blood pressure) is a secondary mediator in the stress process. Chronic activation of these systems is a risk factor for developing chronic disease (Ganster & Rosen 2013).

Cortisol

Cortisol levels typically follow a diurnal rhythm peaking during the first hour after waking – known as the cortisol awakening response (CAR) – followed by gradual decreases reaching their lowest levels around midnight (Clow et al. 2010). In this study we focused on both the cortisol awakening response index (CARI) and the decline in cortisol levels from the morning to the evening (CDD). The CARI index is measured by calculating the difference between cortisol levels on awakening and 30 to 45 minutes thereafter (Pruessner et al. 1997). Meta-analytic findings (Chida & Steptoe 2009) suggest that high CARI is positively but weakly associated with a number of psychosocial factors including job stress and other forms of life stress. Job stress and general life stress were most commonly related to higher CARI, whereas fatigue, burnout, and exhaustion were related to lower CARI. This latter effect may relate to a situation of prolonged exposure to stress, where the bodily systems may undergo a dysregulation (counter-regulatory response) and cortisol rebounds to lower levels than is typical (Fekedulegn et al. 2012). This is often referred to as hypocortisolism (Heim, Ehlert & Hellhammer 2000).

The decline of cortisol levels during the day (CDD, also referred to as a decline towards evening or simply a decline) has been less researched in psychophysiological studies than the CAR. CDD can be measured as the difference between the peak level (measured 30 or 45 minutes after awakening) and the evening cortisol level (measured in the evening before going to bed; e.g., Hansen, Hogh & Persson 2011). A meta-analysis (Chandola, Heraclides & Kurami 2010) of the results from 16 studies examining relationships between job stress and post-morning (generally afternoon and evening) diurnal cortisol levels reported inconclusive findings and called for further research on the topic. However, many studies suggest that high cortisol levels in the evening may reflect an insufficient ability to recover (e.g., Harris et al. 2007; McEwen 1998; Ursin & Eriksen 2004). In addition, a slight decline from morning to evening, that is, a flattened cortisol profile, has been associated with psychosocial factors such as heavy workload and job demands (Caplan, Cobb & French 1979; Karlson et al. 2011), high effort-reward imbalance (Liao, Brunner & Kumari 2013), but also with stress-related exhaustion (Lindeberg et al. 2008; Nicolson & van Diest 2000; Sjögren, Leanderson & Kristenson 2006). In sum, despite inconsistencies concerning CDD-findings, it seems that flat cortisol

diurnal profiles are often related to stressful states and environments (Miller, Chen & Zhou 2007).

Blood pressure

High blood pressure – a major cardiovascular disease risk factor – is another physiological indicator that has been linked to job stress (see Ganster & Rosen 2013, for a review). Job strain, long working hours, and high job demands have frequently been associated with higher average daily blood pressure (e.g., Light, Turner & Hinderliter 1992; Schnall et al. 1998). Despite this, other studies report no relation or even an inverse relation between stress and blood pressure (see Nyklíček, Vingerhoets & Van Heck 1996, for a review). For example, Hassoun et al. (2015) showed that less perceived life stress was associated with lower systolic and diastolic blood pressure levels, whereas exposure to objectively measured job stressors (i.e., physical and psycho-social stressors) based on standard occupational classifications was unrelated to blood pressure. Such discrepancies in study findings are likely to be explained by confounding moderator variables, such as differences in the measures used to assess job stress.

Relaxation exercise and park walk as recovery activities

It is well known that relaxation interventions are effective in reducing job stress (see Richardson & Rothstein 2008; van Dixhoorn & White 2005, for reviews). The most frequently used relaxation techniques to achieve a relaxed state, characterized by low physiological activation and positive affect, are deep-breathing and conscious release of muscle tension referred to as progressive muscle relaxation (McCallie, Blum & Hood 2006). In addition, some relaxation exercises include mindfulness components (awareness and acceptance), which have positive effects on psychological outcomes (see Hofmann et al. 2010, for a review). Although very sparse, some empirical findings show that relaxation techniques have the potential to decrease cortisol secretion and/or blood pressure in interventions conducted in workplaces (Nyklíček et al. 2013; Richardson & Rothstein 2008; Yung et al. 2004).

However, as far as we know, relaxation exercises performed during lunch breaks have been examined in only one study. In a small-scale randomized controlled trial (RCT) among 14 call-center agents, Krajewski and colleagues (2011) showed that progressive muscle relaxation reduced employees' cortisol awakening response (CARI) as well as lunchtime and bedtime cortisol levels. Interestingly, the lower cortisol levels at lunchtime and bedtime were observed in the short run (after 0.25 months) while lowered reduced CARI was only found in the long run (after 5–6 months). The intervention covered a period of six months, during which the participants engaged in a 20-minute relaxation exercise during lunch breaks while the matched control group engaged in small talk. Self-reported strain (Krajewski, Wieland & Sauerland 2010) and sleepiness (Schnieder et al. 2013) also decreased

immediately after the lunch break and at the end of the afternoon in the relaxation group.

Park walks combine two elements, which have been shown to be beneficial for well-being and health: exposure to nature and physical activity. Among healthy populations even short exposure to natural environments can reduce mental fatigue and stress and improve well-being (Barton & Pretty 2010; Berman, Jonides & Kaplan 2008; Bratman et al. 2015). Systematic reviews (Bowler et al. 2010; Thompson Coon et al. 2011) have shown that exercising in a natural environment (so-called “green exercise”) improves psychological well-being more than indoor or urban area exercise. Also, in student samples, positive effects of nature walks on cardiovascular measures such as reduced blood pressure or heart rate variability have been reported (Hartig et al. 2003; Park et al. 2010; Song et al. 2015). Yet the evidence for changes in neuroendocrine measures such as cortisol secretion is inconsistent. Findings show that outside the occupational context, walks in natural settings lowered cortisol levels more than urban walks (Lee et al. 2011; Park et al. 2010), have had no effects in comparison to urban walks (Tyrväinen et al. 2014), or have had positive effects similar to those of urban walks (Gidlow et al. 2016).

Regarding the environment, one intervention study investigated the effect of physical activity either in natural or built environments during the lunch break (Brown et al. 2014). This eight-week RCT among 73 office workers showed that self-reported mental health improved in the natural environment lunchtime walking group, but not in the built environment walking group, or among the controls. There was also a decrease in systolic blood pressure in the natural environment walking group compared to the built environment walking group. However, as a decrease in the systolic blood pressure also occurred in the control group, this may suggest that the positive changes in the natural environment walking group were attributable to something other than the trial itself. No changes in other health parameters (e.g., heart rate variability, body mass index) were found. The authors point out that the 20-minute walking exercise was completed twice a week and adherence was poor. This means that the non-significant results may be due to insufficient exposure.

The aim of the present study

The aim of this study was to examine the impact of lunchtime relaxation exercises and park walks on cortisol secretion and blood pressure. This RCT encompassed a two-week intervention period during which the participants were requested to undertake either a 15-minute relaxation exercise, a park walk or spend their lunch breaks as usual (control). This period is rather short, but we expected positive intervention effects since meta-analytic findings have shown that shorter interventions (1–4 weeks) are more effective than longer ones (Richardson & Rothstein 2008). We based our expectations on the stress reaction model, according to which the release of stress is considered as a decrease in strain (Zapf, Dormann & Frese 1996). In our study, this means decreased physiological stress reactions.

Thus we expected to find a reduction in cortisol responses (CARI, CDD) during the intervention weeks in both relaxation exercise and park walk groups. Concerning blood pressure, which was measured three times per day (morning, afternoon, evening), we expected blood pressure in the afternoon to show the most marked decrease in both intervention groups as this measurement was the closest in time following the intervention during lunchtime. The follow-up measurements of cortisol and blood pressure were scheduled for one week after the intervention to examine potentially persisting short-term changes. Based on the accumulation model of stress (Zapf et al. 1996), it is reasonable to expect long-term intervention effects as well. Specifically, the accumulation model states that even when stress is released, it may take longer for an individual's physiological system to get rid of the strain. However, without any detailed theory of change regarding the time (when), duration (how long) and the shape (form over time) of the relationships between the effects of our interventions and their outcomes, it is impossible to make theoretically based choices of time-lags (see Kelloway & Francis 2013).

Method

Design and procedure

This study utilized a randomized controlled trial design and lasted four working weeks in total, with two weeks constituting the intervention period. During the two intervention weeks participants were instructed to engage for 15 minutes during their working day lunch breaks (altogether 10 days) in one of the activities that they were randomly assigned to: 1) relaxation exercise, 2) park walking, 3) usual break activities (control group). Participants in the relaxation and park walking groups were instructed to eat lunch before engaging in their interventions. The randomization (based on computerized random numbers) was done at the organizational level, that is, there were participants from each of the three groups in every organization taking part in the study.

The relaxation exercise was based on the release-only version of progressive muscle relaxation (Öst 1987) and a deep breathing and acceptance exercise (Tuomisto 2007). The release-only version of progressive relaxation primarily targets muscle relaxation and the deep breathing exploits the potential of the vagal influence on the autonomic nervous system. Acceptance refers to refraining from evaluating or labeling one's experiences, that is, being attentive in an accepting and nonjudgmental way (Baer 2003). The relaxation exercise was taught by a psychologist or a trained psychology student for half an hour in a group setting at the organization site before starting the intervention period. The participants were advised that each relaxation session during the intervention period should last 15 minutes and were also given written relaxation instructions.

The participants assigned to the park walking group walked a predetermined route in the nearest park at a low-intensity pace. We had made sure that all the participating companies had a park nearby (within

five minutes' walking distance). The participants were asked to pay attention to their surroundings and to avoid talking during this 15-minute walk. Before the intervention period started, the route was walked once together in a group guided by a trainer, and were given maps showing the route. During the intervention weeks the participants could either walk alone or in groups. Those walking in groups were discouraged from talking to each other, as the idea was to focus on the natural surroundings.

During the four working weeks, measurements for cortisol and blood pressure were taken on eight days: on Tuesday and Thursday before the intervention, during the two intervention weeks, and the week immediately after the intervention. For practical reasons the four-week RCT was carried out in two phases in 2014: spring (weeks 19–22) and fall (weeks 36–39). The procedure was exactly the same both times, meaning that the fall intervention study constituted a replication of the spring intervention (see **Figure 1**, for the study design).

After the study, all participants received written individual feedback on their physiological indicators and were invited to attend a lecture about the benefits of natural environments and relaxation. We also raffled three travel vouchers worth 400€ in total among all those who had completed the online questionnaire at the beginning of the study. The research was approved by the Ethics Committee of the Tampere Region (Statement 10/2014) and the trial was duly registered (NCT02124837). The full study protocol has been published by De Bloom, Kinnunen and Korpela in 2014.

Participants

The participants were recruited with the help of a Finnish company supplying occupational health care services in the city of Tampere and its surroundings. The following exclusion criteria were applied: a) shift work or extremely irregular working hours and b) serious illness or allergies rendering walking outdoors impossible. Of the approximately 2,226 people approached, 279 replied and met the criteria (see **Figure 2**). In the end, people from seven different companies participated.

For practical reasons a company was included in the study when at least six of its employees volunteered to participate. This precondition reduced the group of participants from 279 to 225. Of the remaining 225 participants, 53 dropped out either before (48) or during (5) the intervention for various reasons (e.g., sickness, travel or holiday plans during the intervention weeks). Five of these 53 individuals dropped out before the participants had been randomized into the study groups. Of the 48 later dropouts, 18 (24%) left the park walk group, 20 (26%) left the relaxation group and 10 (14%) left the control group. The number of dropouts between the study groups did not differ significantly ($\chi^2(2, 220) = 3.50, p > .05$). Furthermore, 19 participants had to be excluded because 1) they did not engage in the park walking/relaxation exercise intensively enough (less than six out of ten times, 13 participants) or 2) their data were largely missing (six participants). The final sample included 153 participants (see **Figure 2**).

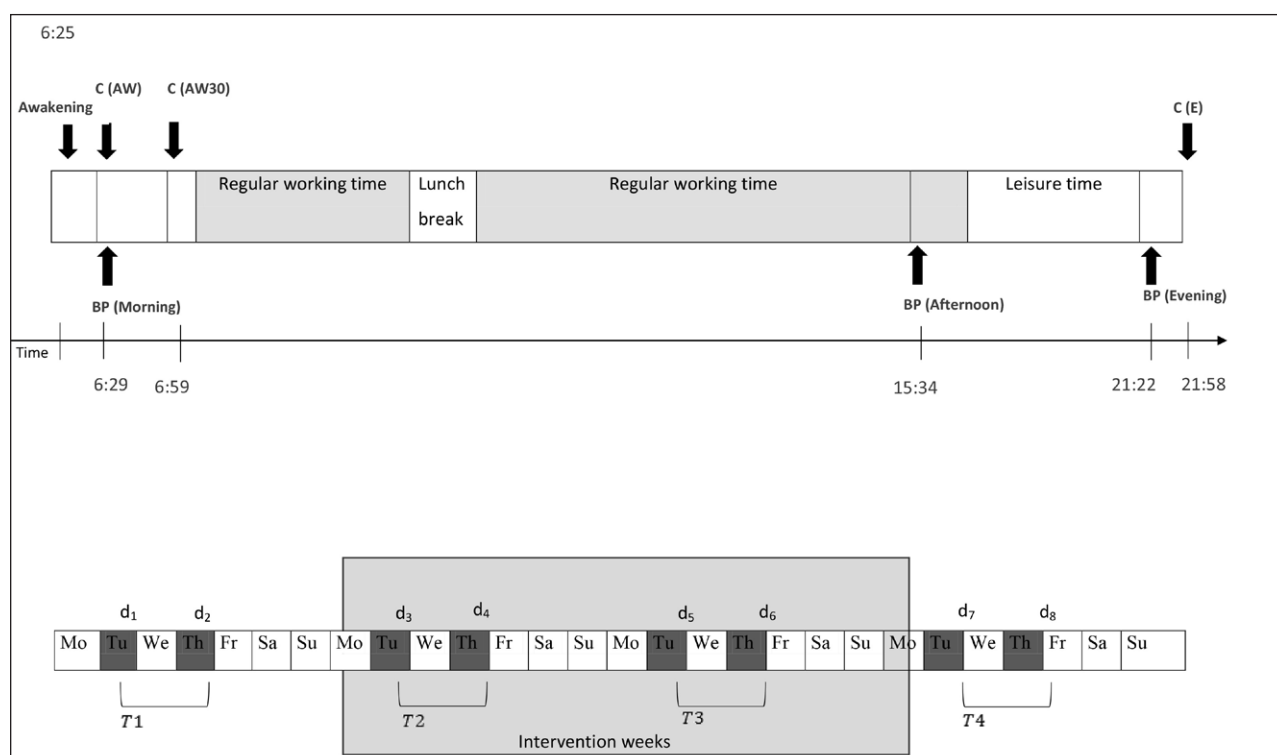


Figure 1: Average awakening times and taking the measurements [C (AW) = Cortisol after awakening; C (AW30) = Cortisol 30 minutes after awakening; C (E) = Evening cortisol; BP = Blood pressure] are shown in the upper part of the figure. Measurement days [d_{1–8} = measurement day; T1 = baseline, T2 = first intervention week, T3 = second intervention week, T4 = follow-up] are shown in the lower part of the figure.

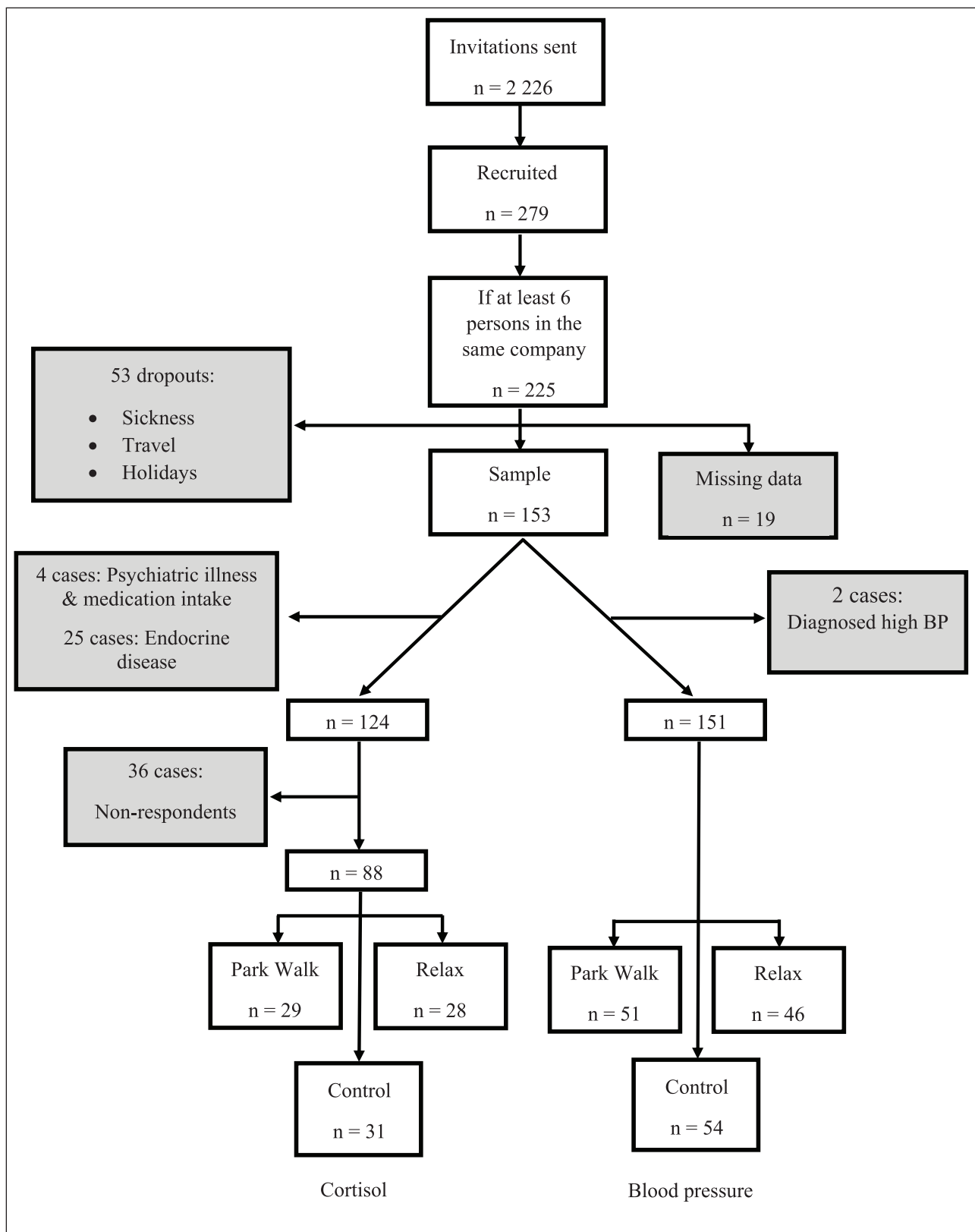


Figure 2: Flowchart of participants.

Measurements

Before the study started, we organized training sessions in every organization during working hours. In these sessions we went through the research protocol, practiced the intervention activities and explained how to collect saliva samples and measure blood pressure. All instruc-

tions were also included in the paper-pencil booklets in which the participants reported their measurements. At the end of the training session, all participants provided written informed consent.

Before and after the daily lunch break intervention, participants in the intervention groups reported their *level*

of tension on a scale from 0 to 100 in the paper-pencil booklet. The scale was anchored as follows: 0 = extremely relaxed, such as sitting on the couch after exercising and having a sauna bath, 50 = normal level of relaxation/tension, 100 = extremely tense, such as before a major, stressful life event or an important speaking appearance in public.

Cortisol was sampled from saliva using Salivette swabs. To measure CAR, the samples were taken immediately on waking (AW) and 30 minutes after waking (AW30). The third sample was collected in the evening before going to sleep (see **Figure 1**). The participants wrote down the exact times of awakening and saliva sampling in the paper-pencil booklet. They were also asked to refrain from eating, drinking, heavy physical exercise and brushing their teeth for 30 minutes before saliva sampling. To assess compliance, the participants were asked to report in their booklets whether they had engaged in any of these behaviors or had taken medication ("Please tick [the box] if you did any of the following activities within the last 30 minutes") before sampling saliva or measuring blood pressure levels.

The saliva samples were stored in the participants' home refrigerators until sample collection was completed, and then collected by the researchers in chilled boxes, mailed to and analyzed at the Finnish Institute of Occupational Health, as these samples tolerate the prevailing temperatures during shipment (Stalder et al. 2016). Values of salivary cortisol were analyzed using a LIA kit (LIA, IBL, Hamburg, Germany) and reported in nmol/l.

We calculated CARi by determining the difference between cortisol values at awakening +30 (AW30) and awakening (AW). A smaller (less steep) CARi indicates better physiological recovery. CDD was calculated by determining the difference between cortisol values at awakening +30 (AW30) and bedtime. Unlike the CARi, a CDD index increase is related to better physiological recovery. We averaged the cortisol values of Tuesday and Thursday for every week, as there were no significant differences between days ($t = -2.08-1.31$; p values $> .05$, using Bonferroni correction). Moreover, averaging the two days also made the indexes more robust week-level indicators and less prone to irrelevant daily fluctuations. Before combining the spring and fall data sets in the analyses, we checked that the spring and autumn RCTs did not differ significantly in cortisol (AW, AW30, evening; $t = -2.15-0.74$; p values $> .05$).

Employees measured their *blood pressure (BP)* using a digital blood pressure monitor (Omron M2) three times a day (after waking, in the afternoon about 30-60 minutes before the end of the working day and before going to bed). At every measurement, participants measured their resting BP after a five-minute resting period. They always measured their blood pressure twice with a two-minute time period between measurements to ensure measurement reliability. The participants wrote down in the booklet the exact values of their systolic BP (SBP) and diastolic BP (DBP) in mmHg (as automatically displayed by the monitor). We calculated an average of these two highly

correlated measurements ($r = .85-.91$, $p < .001$, and $r = .92-.94$, $p < .001$), for all systolic and diastolic BP measurements. We averaged the values on Tuesday and Thursday for every week. Of the 24 t -tests performed, only SBP on awakening in the first week (T1) was significantly higher on the Tuesday than on the Thursday after Bonferroni correction ($t = 3.39$, $p = .001$). Additionally, as the BP values of the spring and autumn RCTs did not differ significantly ($t = -1.77-0.76$; p values $> .05$ using Bonferroni correction), we used the whole sample in the analyses.

Background information (gender, education, age, weekly working hours, workload, autonomy and social support at work, job exhaustion, diagnosed psychiatric or endocrine diseases, and hypertension) was collected through an online questionnaire at the beginning of the study. Workload, autonomy, and support describe the key characteristics of any job based on Karasek's model (Karasek & Theorell 1990). *Workload* was measured with three items (e.g., "How often does your job require you to work under time pressure? Cronbach's alpha = .88") from the QWI (Spector & Jex 1998). *Job autonomy* (5 items, e.g., "I have flexibility in setting my own working hours", Cronbach's alpha = .77) and *social support from colleagues and supervisors* (6 items, e.g., "If needed, I can get support and help with my work from my coworkers", "My work achievements are appreciated by my immediate superior," Cronbach's alpha = .78) were measured with items from the QPS Nordic-ADW (Dallner et al. 2000). All items were rated on a scale ranging from 1 (very seldom or never) to 5 (very often or always). *Job exhaustion* was measured with five items (e.g., "I feel emotionally drained from my work", Cronbach's alpha = .94) from the MBI-General Survey (Maslach, Jackson & Leiter 1996), which has been validated in Finland (Kalimo, Hakanen & Toppinen-Tanner 2006). The response scale ranged from 0 (never) to 6 (every day). Diseases were assessed by single items (yes = 1, no = 0).

Data exclusion and statistical analyses

When analyzing cortisol data, we screened the data to ensure the validity of measurements. We excluded four participants with a physician-diagnosed psychiatric disease and 25 with endocrine diseases from the sample. Furthermore, 36 participants were excluded as they had systematically flattened or negative CAR profiles (i.e., on more than on 50% of the days the rise from awakening to awakening +30 measurement was less than 2.5 nmol/l; Wüst et al. 2000). These so-called CAR non-respondents were equally distributed among the intervention and control groups ($\chi^2(2, 87) = .38$, $p = .83$). The final cortisol sample included 88 participants (see **Figure 2**).

Single cortisol samples (values) were also excluded: Each of the three measurements per day was repeated on two days per week over four weeks, thus our study resulted in 24 cortisol values per person and 3,672 cortisol values in total. Outliers beyond three standard deviations from the mean (137 values, 3.7%) were first removed. In addition, when a participant had consumed alcohol before collecting the sample (9 values), did not collect samples at the

appointed times (i.e., over 15 minutes' self-reported delay in the morning sample compared to awakening time, 78 values), or had an occasional flat or negative CAR (330 values). These conditions accounted for 417 excluded values (11.4%).

Cortisol data had skewed distributions and were Log10 transformed. Next, we analyzed the patterns of missing data. The missing data items ranged from 13.6% to 19.3% for CARi and from 13.5% to 21.6% for CDD per measurement time. Detailed inspection of the missing data items showed that the highest rates of missing data were to be found in the last week of the study (T4). In these circumstances, data imputation was needed to increase both statistical power and external validity (see Newman 2009). The most common and recommended missing data imputation method is multiple imputation based on maximum likelihood estimation (Horton & Kleinman 2007; Schafer & Graham 2002). This method completes missing data with values randomly generated from an adjusted distribution for the outcome variable and covariates, repeating the procedure multiple times. The results are then pooled to obtain point and variance estimates for the variable of interest. Accordingly, we conducted multiple imputations using logistic regression with five imputation subsamples to generate the pooled imputed dataset.

Similarly, when analyzing BP data, we screened the data to ensure the validity of the measurements. As each of the three measurements per eight days were repeated at two-minute intervals and produced both SBP and DBP values, our study resulted in 96 BP values per person and thus in a total of 14,688 BP values. Clearly erroneous single values (4 values, 0.03%) and outliers beyond three standard deviations from the mean (63 values, 0.4%) were removed. Single values were also removed if participants had consumed alcohol before measuring BP (which occurred on nine occasions before evening measurements resulting in 36 excluded values, 0.3%) or had exercised heavily (which occurred on 14 occasions before evening measurements resulting in 56 excluded values, 0.4%). Furthermore, we checked that the measurements were taken at the times advised (six values, 0.04%, excluded for this reason). We excluded two cases with diagnosed hypertension having systematically and atypically high BP values (more than two standard deviations above the sample average). After this data cleaning, the final sample for BP analyses included 151 participants (see **Figure 2**). Imputation was not needed for the BP data as the number of missing observations remained low.

We used mixed-design ANOVAs to test whether the three groups (relaxation, park walk, and control) differed in CARi, CDD, SBP, and DBP over the intervention period (T1–T4). The intervention and control groups acted as a between-groups factor and time was a repeated measure. A significant Group \times Time interaction effect would suggest a significant effect of the intervention, that is, the physiological indexes would show different changes across time in the three groups. To understand the magnitude of these differences, we also calculated effect sizes (Cohen *d*)

comparing the physiological indexes at baseline (T1) and in the second intervention week (T3). We expected that the effect of the intervention would be largest towards the end of the two-week intervention period. Effect sizes smaller than 0.2 are considered trivial, *d*'s between 0.2 and 0.5 are defined as small, *d*'s between 0.5 and 0.8 are considered medium, and *d*'s greater than 0.8 are interpreted as large effect sizes (Cohen 1992; Sullivan & Feinn, 2012). All analyses were performed using SPSS 22.

Results

Main sample characteristics and adherence to protocol

There were no differences in background factors (gender, education, age, weekly working hours, workload, autonomy, social support, exhaustion) and waking times between the intervention and control groups when the cortisol data at baseline were analyzed. For BP data, however, differences in education emerged: the intervention groups had higher educational levels than did the control group ($\chi^2(2, 150) = 7.45, p = .02$; see **Tables 1** and **2**). However, education did not correlate with BP values ($r = -.08-.12; p > .05$). Age was positively associated with BP ($r = .23-.44; p < .05$), but there were no significant age differences between the intervention and control groups ($F(2, 132) = 1.31, p = .27$).

Time of waking correlated negatively with CARi on the first ($r = -.34, p < .05$) and fifth ($r = -.30, p < .05$) measurement days, indicating that the earlier the participants woke up the steeper the CARi index. Additionally, CDD correlated positively with waking time on the sixth day ($r = .26, p < .05$), that is, the later participants woke, the higher their CDD index. However, there were no differences between the two intervention and the control groups in waking times on any of the eight measurement days ($F = 0.32-2.21, p > .05$).

Tables 1 and **2** show – besides the main characteristics of the sample – cortisol and BP values at baseline for each group. No group differences in cortisol or in BP values at baseline emerged.

Regarding adherence to protocol, we examined whether there were significant group differences in terms of the number of exercises completed, exercise duration, and the length of the lunch breaks. On average, participants engaged in relaxation exercises or park walks 8.6 times out of ten during the two-week intervention period. There were no differences in the frequency of relaxation exercises or park walks ($F(1, 95) = 0.14, p = .71$). This held for participants with both cortisol and BP data. In the relaxation group lunch breaks lasted on average 27 minutes and the exercise on average 14 minutes (range: 8–20). In the park walk group lunch breaks lasted on average 28 minutes, of which the participants engaged in the exercise for 15 minutes (range: 8–20), and for the control group, lunch breaks lasted 27 minutes on average (range: 10–60). Park walks lasted on average 1–2 minutes longer than the relaxation exercises ($F(1, 88) = 15.2, p < .01$). This was the case for both cortisol and BP data. There were no statistically significant group differences in the lunch break duration ($F(2, 150) = 0.05, p = .95$). In both intervention groups the levels of tension decreased significantly on every intervention day in

Table 1: Main sample characteristics for cortisol for the baseline week (n = 88).

Variables	Relaxation (n = 28)	Park walk (n = 29)	Control (n = 31)	<i>p</i> [†]
Female, %	89	90	87	.94
Higher education ¹ , %	46	50	47	.53
Age in years (mean)	46	47	48	.67
Working h/w (mean)	38.2	38.3	38.7	.87
Workload	3.8	3.7	3.9	.69
Autonomy	3.4	3.5	3.4	.92
Social support	4.1	4.1	4.0	.77
Exhaustion	1.9	2.0	2.2	.67
Awakening time, h (mean)	6:23	6:17	6:10	.44
Cortisol ² AW	16.0	18.5	16.0	.65
Cortisol ² AW+30 min	30.3	31.1	28.7	.77
Cortisol ² bedtime	4.8	4.3	4.7	.85

Notes. Abbreviation: AW = Awakening time.

¹ Higher education = Master's degree or higher.

² Cortisol in nmol/l without log-transformation.

p[†] Refers to a chi-square test for categorical variables or to a *F*-test for continuous variables.

Table 2: Main sample characteristics for blood pressure for the baseline week (n = 151).

Variables	Relaxation (n = 46)	Park walk (n = 51)	Control (n = 54)	<i>p</i> [†]
Female, %	91	92	87	.64
Higher education ¹ , %	54	44	28	.02
Age in years (mean)	46	48	48	.27
Working h/w (mean)	38.6	38.2	38.4	.89
Workload	3.8	3.8	3.9	.84
Autonomy	3.2	3.4	3.4	.60
Social support	4.0	4.0	4.0	.99
Exhaustion	1.8	2.0	2.2	.21
Awakening time, h (mean)	6:18	6:15	6:15	.61
Morning SBP (mean)	118.1	117.4	115.0	.43
Morning DBP	74.7	75.1	72.8	.35
Afternoon SBP	127.4	125.5	124.2	.45
Afternoon DBP	79.3	78.6	77.5	.51
Evening SBP	118.3	117.0	115.3	.43
Evening DBP	72.8	73.0	71.6	.57

Notes. Abbreviations: SBP = Systolic blood pressure; DBP = Diastolic blood pressure; measured in mmHg OK.

¹ Higher education = Master's degree or higher.

p[†] Refers to a chi-square test for categorical variables or to a *F*-test for continuous variables.

the intervention groups. In the park group, tension decreased from an average of 57.1 before the lunch break to an average of 42.4 after the lunch break ($t(44) = 7.24, p < .001$). In the relaxation group tension decreased from 58.7 to 40.9 ($t(35) = 6.83, p < .001$).

ANOVA results

Mixed-design ANOVAs were conducted to address the intervention effects. **Table 3** shows the results for cortisol. There were no differences in the CARi index in terms of time, group or interaction effects. Thus the intervention

Table 3: Mixed ANOVA results for cortisol.

	T1		T2		T3		T4		Δ T3–T1	Cohen's <i>d</i>	F-statistic		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			Time	Group	G \times T
CARI													
Relax	14.5	9.6	14.2	9.1	19.2	11.1	16.3	8.7	4.7	.38	1.60	.85	.55
Walk	12.8	8.1	12.0	5.5	15.7	10.8	18.1	15.6	2.9	.20			
Control	12.7	5.0	13.3	8.1	14.1	8.5	14.0	13.5	1.4	.16			
CDD													
Relax	12.1	8.2	11.0	9.9	13.1	8.7	12.7	4.9	1.0	.09	2.26	.20	2.30*
Walk	11.8	9.3	11.6	8.8	12.3	8.9	12.1	8.1	0.5	.05			
Control	10.9	8.8	16.6	14.4	11.8	9.6	15.4	11.5	0.9	.11			

Notes. Means (*M*), standard deviations (*SD*), mean differences and Cohen *d* were calculated using non-transformed cortisol values; *n* = 28, 29, and 31, for relaxation, walk, and control groups respectively.

* *p* < .05.

did not have any effect on lowering the cortisol awakening response in the intervention groups compared to the control group, which was contrary to expectation. The results for the CDD index, addressing cortisol decline throughout the day, suggest a significant interaction effect between group and time. Specifically, changes in CDD in the control group differed from those in the intervention groups. The mean values of the CDD index remained stable in the intervention groups compared to the control group, where there was more variation with steeper rises at T2 and T4 (see **Table 3**).

In **Table 3** the mean differences in the CARI index between T3 (at the end of the intervention) and T1 (at baseline before the intervention) are positive. This indicates a steeper increase in the awakening cortisol response at the end of the intervention compared to baseline before the intervention in all three groups. The greatest increase from T1 to T3 was seen in the relaxation group (*d* = .38). Thus the changes observed in CARI were contrary to our expectations. Instead, the differences in the CDD were in the expected (positive) direction, showing a slight decline between T3 and T1, but with trivial effect sizes.

For BP (**Table 4**), significant time effects emerged for four out of the six values (SBP and DBP at morning, afternoon, and evening), but no significant interaction or group effects were observed. Thus, in view of the ANOVA results, the intervention and control groups did not differ in BP over time. The significant time effects were observed in the afternoon at the end of the working day, but also in the morning. BP showed a decreasing trend over time.

Regarding the differences between T3 and T1, the trend involved decreasing SBP and DBP in every measurement (morning, afternoon, and evening) for all groups. However, the decrease was most pronounced in the walking group (*d* = .28–.58) and smallest in the relaxation group (*d* = .00–.28). The greatest decrease in the walking group was seen in SBP (*d* = .58) and DBP (*d* = .51) in the afternoon.

Discussion

This study with its focus on the physiological effects of a recovery intervention during the working day is among the first RCTs in this research area. Specifically, we examined whether physiological stress markers of cortisol and blood pressure would change during and after a two-week intervention consisting either of a 15-minute relaxation exercise or a park walk taken on every working day at lunchtime compared to a control group spending their lunch breaks as usual. Although the evidence of changes in physiological markers is limited regarding interventions during working days (see Richardson & Rothstein 2008, for a review), both relaxation exercises and park walks have shown positive effects, especially for blood pressure, but mostly in studies conducted outside the occupational context (Hartig et al. 2003; Nyklíček et al. 2013; Park et al. 2010; Song et al. 2015).

Our hypothesis that the cortisol awakening response (CAR) would show a flattened profile and that there would be a decline in cortisol excretion over the day (CDD) in the intervention groups after the two-week intervention period was not supported. Thus our findings did not support the hypotheses of the stress reaction or accumulated stress models (Zapf et al. 1996). In fact, we noticed an opposite tendency – a steeper profile – in the cortisol awakening response at the end of the intervention compared to the baseline before the intervention. Importantly, this tendency was more pronounced in the relaxation group (*d* = .38) than in the walking or control groups. This means that our findings are opposed to those reported by Krajewski et al. (2011) who, in examining the effects of relaxation exercises during lunch breaks showed a flattened CAR profile in the relaxation group. However, this reduced CAR was only observed in the long run (after 5–6 months). Concerning park walks, there is no research on cortisol comparable to our lunch break intervention study, although some studies have shown that walks in natural surroundings lower cortisol values more than do urban walks (Lee et al. 2011; Park et al. 2010).

Table 4: Mixed ANOVA results for blood pressure.

	T1		T2		T3		T4		Δ T3–T1	Cohen's <i>d</i>	<i>F</i> -statistic		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			Time	Group	G × T
Morning SBP													
Relax	118.1	12.6	117.6	12.2	116.9	12.1	117.4	12.9	−1.2	.16	4.3**	1.45	.198
Walk	117.4	11.2	116.4	10.8	115.0	10.8	116.1	11.3	−2.4	.33			
Control	114.9	13.5	114.2	11.2	112.3	14.0	113.6	12.4	−2.6	.39			
Morning DBP													
Relax	74.7	8.1	73.7	7.8	73.8	7.7	74.8	7.8	−0.9	.18	4.86**	1.22	.435
Walk	75.1	8.0	73.7	7.6	73.2	7.8	74.0	8.2	−1.9	.44			
Control	72.8	9.4	72.1	6.6	71.5	8.4	72.2	8.4	−1.3	.27			
Afternoon SBP													
Relax	127.3	13.7	120.6	13.9	125.6	11.6	125.1	11.4	−1.7	.18	24.68***	.89	.15
Walk	125.5	9.5	119.8	9.7	121.3	9.3	124.8	10.0	−4.2	.58			
Control	124.4	12.1	118.8	13.2	120.6	10.3	124.4	12.9	−3.8	.41			
Afternoon DBP													
Relax	79.3	7.5	75.5	7.7	78.0	6.6	78.6	6.4	−1.3	.28	20.23***	.94	.69
Walk	78.6	7.1	75.6	7.3	76.1	7.0	78.9	7.5	−2.5	.51			
Control	77.6	8.4	74.3	8.6	75.2	8.0	77.3	8.2	−2.4	.31			
Evening SBP													
Relax	118.3	11.7	116.8	12.3	117.3	9.9	119.1	12.2	−1.0	.12	1.50	.98	1.01
Walk	117.0	10.3	119.2	19.2	115.0	9.8	116.9	9.5	−2.0	.28			
Control	115.3	12.3	115.8	14.1	114.2	11.0	115.1	12.0	−1.1	.15			
Evening DBP													
Relax	72.8	6.7	72.8	8.9	72.8	7.5	74.1	7.7	0.0	.00	1.59	1.02	1.03
Walk	73.2	7.7	75.0	17.5	71.3	7.7	72.6	6.7	−1.9	.36			
Control	71.6	8.5	71.7	10.4	70.6	8.3	71.1	8.6	−1.0	.20			

Note. SBP = systolic blood pressure; DBP = diastolic blood pressure; *n* = 46, 51, and 54, for relaxation, walk, and control groups respectively.

*** $p < .001$, ** $p < .01$.

These differences in study findings may indicate that the effects of relaxation exercises and park walks on changes in CAR need a longer intervention period. In particular, this may be the case for relaxation exercises where participants first need to learn the skill of relaxation to experience a really deep and effective relaxation during a lunch break. At the beginning, such relaxation exercises may require extra effort, which may be manifested as a tendency for a steeper CAR profile. A small steeper effect in CAR ($d = .20$) was also observed in the park walk group, whereas the effect in the control group was trivial. Although park walks did not demand any extra learning effort as the relaxation exercises, the walks did change participants' lunch break routines. Thus a longer exposure to the intervention, during which the participants would have fully internalized the relaxation procedure and acquired their new lunch break routines, would perhaps

have been needed. Also, the aggregate cortisol measures of HPA-axis activity included here are typically fairly stable and may require longer follow-ups to discern any changes.

The BP results revealed a decrease in both SBP and DBP at the end of the intervention, especially in the park walk group, but also in the control group. These effects were most clearly pronounced in the afternoon before the end of the working day. Again, our expectation remained unmet, as the group × time interaction effect was non-significant. Moreover, the significant time effect revealed that there was a BP decrease in the control group as well. However, the expected timing when the effects might be strongest was confirmed. In the afternoon the effects were medium sized ($d = .51$ – $.58$) in the park walk group and small ($d = .31$ – $.41$) in the control group. Similar but smaller effects were also detected in the morning and even in the evening BP values.

Brown et al. (2014) found quite similar effects, as in their lunch break intervention study short walks in a natural environment twice a week lowered SBP which also occurred in the control group. In their study, however, both these groups (walk in a natural environment and control) had pre-hypertensive values (> 130) in contrast to the third group, which walked in an urban environment. Consequently they concluded that the intervention was not able to modify baseline BP within normal ranges. In our study, all participants had BP values within the normal range and the baseline levels of the three groups were comparable. Thus it is difficult to explain why the decrease was clearer in the control group than in the relaxation group, which only showed a small-sized effect ($d = .28$) in afternoon DBP after the intervention.

The three groups did not differ in any background factors, key job characteristics (workload, autonomy, and social support) and exhaustion. However, there was a difference in education, with controls having the lowest educational level. Yet there was no association between education and BP. This suggests that the differences observed were unrelated to these factors. However, it is possible that in the control group regularly checking BP levels involved an intervention to lower it. For example, the participants perhaps paid more attention to factors relating to blood pressure (e.g., eating, alcohol consumption, and physical activity). As for the intervention, the adherence was equally high in both intervention groups, although the park walks lasted 1–2 minutes longer than the relaxation exercises probably due to the time needed to go to and come back from the nearby park. In the relaxation group the benefits for physiological recovery may take longer than two weeks to emerge but, taken together, the effects observed in BP were short-lived, as the values tended to return to baseline levels at T4, that is, one week after the end of the intervention period.

Limitations and suggestions for future research

First, it is well known that carrying out physiological measurements outside a controlled laboratory setting is challenging. We cannot ascertain whether participants adhered to instructions and followed the study protocol. Accordingly, participant adherence in this kind of field study with repeated measurements (i.e., eight days with three cortisol and BP measurements per day) needs special attention. To improve adherence we arranged an initial face-to-face meeting in every organization participating in the study. In this meeting we went through the study protocol in detail and emphasized the importance of adherence. Also, all participants received written instructions to read at home. In addition, we used reminders (text messages) to remind all participants of the measurement days. Despite this, there were dropouts (53 participants) and individuals who did not follow the instructions (19 participants). The dropout rate did not differ significantly between study groups, indicating that participants in each study group were equally committed to the study. We carefully screened the data concerning sampling time points and several control variables (e.g., gender, age, diseases, medications taken, physical activity, smoking, alcohol con-

sumption) and excluded both cases and single values from the data to remove “noise” distorting the findings. Thus we were careful to optimize the quality of the data.

Nevertheless, future studies should, if possible, use an objectively verifiable timing of measurements (Stalder et al. 2016). In addition, we could not take account of all factors affecting cortisol levels or BP values. For example, despite our sample including mostly women, no information on menstrual phase was obtained. Nevertheless, this has little or no effect on CAR. Three assessments (on waking, 30 min and 45 min later) are recommended for studying CAR, but we were restricted to a two-sample protocol (0 and 30 min after awakening), which may have compromised the CAR and the measurement of peak timing.

Second, despite randomizing participants at the department/organization level, we were unable to avoid possible contamination between groups as participants from all three groups worked in the same department or organization and may have discussed the research project and their new routines. This may be another reason for why the control group showed BP improvements. It is also good to keep in mind that our sample is selective (e.g., mostly women, healthy workers), which reduces generalizability to other groups. This means that future studies of adequate physiological stress markers measuring the effects of short interventions similar to the ones examined here are needed.

Third, future studies would also benefit from including a process evaluation, which is an emerging field in organizational intervention research (Biron & Karanika-Murray 2014; Nielsen & Simonsen Abildgaard 2013; Nytro, Saksvik, Mikkelsen, Bohle & Quinlan 2000; Saksvik, Nytro, Dahl-Jørgensen & Mikkelsen 2002). Although our intervention study was carried out in a work life setting, within different organizations, it was an individual level intervention targeting employees. Yet, focusing on the processes, that is, assessing how, when and why things happen, would likely have helped to understand the changes in each group. For example, asking how satisfied participants were with the group they were assigned to and whether they discussed the intervention exercises with their colleagues would have been helpful in explaining our results. Yet the dropout analyses suggest that there was an equal number of dropouts in every study group, implying that participants in each group were equally satisfied with their group assignment. Nevertheless, as autonomy seems important in increasing positive lunch break effects on well-being (Troughakos et al. 2014), randomization into the three intervention groups limited participants' autonomy, which may have restricted the beneficial impact of specific lunch break activities. It is also likely that the participants discussed the study content and goals with their colleagues, as they knew who was taking part in the study. This may have influenced their behavior and/or physiological reactions to the intervention. In sum, it would have been helpful to have had systematically collected data regarding these issues, for example, by interviewing a part of the participants in every group. Unfortunately, however, such a systematic approach was unfeasible in this study.

Future intervention studies would moreover benefit from using a design in which each participant alternates between engaging in the different recovery activities of interest or a wait-list control design. This would improve perceptions of fairness among controls. Also, longer intervention periods (i.e., > 2 weeks) may be needed. Here, however, due to the restricted time available among the employees, such designs and longer periods were not feasible.

Conclusion

Our controlled trial is one of the first studies to apply physiological measurements in a field setting to investigate the impact of different lunch break activities on employees' cortisol and blood pressure levels. Our study showed that changes in employees' lunch routines for a short period of time did not affect cortisol responses. However, park walks during lunch breaks seem to be a promising strategy for lowering BP, especially at the end of the working day, although this effect was also found, albeit to a lesser extent, among controls. Thus mere BP measurements may serve as an intervention to reduce physiological stress at the end of the working day. Theoretically, our study findings did not support the stress reaction or the stress accumulation models. This suggests that detailed models of change are needed to guide research. Nevertheless, our results suggest that cortisol measures of HPA-axis activity may require longer exposure time to discern any changes. Importantly, future studies using longer intervention periods, longer follow-ups and detailed process evaluations are needed. Longer exposure times to the interventions are likely to produce more marked and longer lasting physiological recovery effects, and process evaluation may help to explain why an intervention fails or succeeds.

Competing Interests

The authors have no competing interests to declare.

Author note

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